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DIAGRAMS OF THE NERVES OF THE HUMAN BODY;

EXHIBITING THEIR ORIGIN, DIVISIONS, AND CONNECTIONS, WITH THEIR DISTRIBUTION
TO THE VARIOUS REGIONS OF THE CUTANEOUS SURFACE
AND TO ALL THE MUSCLES.

BY

WILLIAM HENRY FLOWER,

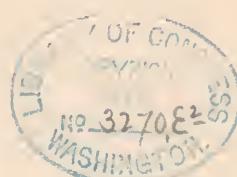
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SECOND AMERICAN FROM THE SECOND ENGLISH EDITION.

EDITED, WITH ADDITIONS, BY

WILLIAM W. KEEN, M.D.,

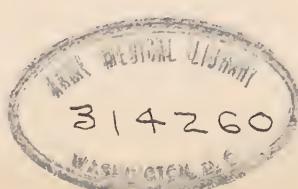
LECTURER ON ANATOMY AND OPERATIVE SURGERY IN THE PHILADELPHIA SCHOOL OF ANATOMY;
LECTURER ON PATHOLOGICAL ANATOMY IN THE JEFFERSON MEDICAL COLLEGE,
FELLOW OF THE COLLEGE OF PHYSICIANS, &c.



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1874

EDITOR'S PREFACE TO THE FIRST AMERICAN EDITION.

THE signal benefit derived from these diagrams as illustrations in teaching, and their great convenience for ready reference in practice, have led to their republication, reduced to one-fourth the size of the originals.

The Editor has made some additions where greater detail seemed desirable, has grouped the spinal nerves in their plexuses, and has added to the text a synopsis of the various sympathetic ganglia. His alterations have been very slight, and limited almost exclusively to the mechanical arrangement, *e. g.* in the mode of bifurcation of the brachial plexus.

1729 CHESTNUT STREET, PHILADELPHIA,
January 1, 1874.

PREFACE TO THE SECOND EDITION.

THESE diagrams were originally published in 1860. They were designed by the author while engaged in teaching anatomy at the Medical School attached to the Middlesex Hospital. They have no pretensions to enlarge the boundaries of the knowledge already existing upon the subject, but aim at placing that knowledge in a form easily accessible, as well to students, as to those whose avocations no longer afford time or opportunity for elaborate anatomical investigations.

The distribution of all the nerves of the body, so far as the branches have received distinctive appellations, is shown, and their divisions are traced to the muscles and to the various regions of the cutaneous surface. To afford greater facility for reference, the names of the muscles are printed in red letters; those of the nerves being black.

It must be clearly understood that the plates are only diagrams or plans, and that in reducing to a plane surface objects which are in reality superimposed at various distances, and which sometimes cross one another, their mutual relations and proportions must often be disarranged.

In the plexuses and other parts which vary somewhat in different subjects, the average distribution in its most simple form has been selected for illustration; and in difficult or disputed points, such as the connecting branches of the cranial nerves, only those which are established on good authority are introduced.

As few things tend to embarrass the student so much as a diversity of nomenclature, that used in the sixth edition of Quain's Elements of Anatomy by Dr. Sharpey and Mr. Ellis, has been adopted throughout.

The principal materials for the composition of these diagrams have been obtained by repeated dissections; but the author desires to acknowledge the assistance derived from the above-named work, from that of Swan, and from the beautiful plates of Hirschfeld and Leveillé.

In the present Edition, the size of the diagrams has been considerably reduced, the convenience and portability of the work being thereby increased, without any detriment to its clearness and legibility. In revising the plates, the author has availed himself of some suggestions, for which he is indebted to the kindness of Professor Turner, of Edinburgh, of Mr. J. Beswick Perrin, and of Dr. W. W. Keen, of Philadelphia.

PLATES I. AND II.—THE CRANIAL NERVES.

UNDER this name are included the twelve pairs of nerves arising from the cerebro-spinal axis, which are transmitted to their destination through apertures in the base of the skull.

The numerical nomenclature of the cranial nerves, introduced by Willis, had become so completely incorporated into our medical, anatomical, and physiological literature before its errors were discovered, that it would be impossible now to discard it altogether. The arrangement of Sömmering, in which each of the five pairs of nerves forming the seventh and eighth of Willis is recognized as distinct, is more correct, and is already very generally used upon the Continent. In the diagrams the two systems are placed for comparison in contiguous columns.

In the first explanatory column the superficial or apparent origins of the nerves only are given. Although the deep or real origins are unquestionably of greater physiological importance, they are so complex, and in many cases so incompletely made out, that they could not have been accurately stated in that concise form required in a tabular exposition.

Most of the cranial nerves are connected by fine filaments with branches of the sympathetic system. The physiological import of these communications being still imperfectly understood, the words *to* and *from* applied to them must be taken in an anatomical sense only, and not necessarily as implying the presumed direction of the current of nerve force.

The FIRST PLATE illustrates the distribution of the first six pairs of cranial nerves.

I. *The Olfactory Nerve* is especially appropriated to the sense of smell. Although commonly described as a nerve, this, with its expanded extremity, should more properly be considered as a portion of the encephalon, as it contains much gray matter, has no sheath or neurilemma, and is homologous to the more fully developed *olfactory lobes* of the lower animals.

From the under surface of the bulb about twenty delicate nerves are given off; these pass through the foramina in the cribriform plate of the ethmoid bone, and are distributed to the mucous membrane lining the upper two-thirds of the nasal fossæ.

II. *The Optic Nerve* is the special nerve of the sense of sight, and terminates in the retina. The nerves of opposite sides are connected together at the *commissure*. From their origin up to this point, being in the form of flattened bands, they are called *optic tracts*.

III. *The Third Nerve (Motor Oculi)* is entirely motor in its function. It supplies branches to five of the seven muscles of the orbit, and one (the short root) to the ophthalmic ganglion, thereby giving motor power to the iris.

IV. *The Fourth Nerve (Pathetic or Trochlear)* is the smallest of the cranial nerves, and terminates in the superior oblique muscle of the eyeball. It communicates with the sympathetic, and often with the ophthalmic division of the fifth, and according to Bidder, whose observation has been confirmed by Hirschfeld, gives a recurrent filament to the dura mater.

V. *The Fifth Nerve (Trifacial or Trigeminal)* resembles the spinal nerves in having two roots, one endowed with sensory, the other with motor power; but the similarity is only partially carried out, inasmuch as the motor root is of very small size and of comparatively limited distribution.

It is the principal nerve of common and muscular sensibility to the face, confers motor power on the muscles of mastication, and one of its branches contains filaments appropriated to the special sense of taste. As in the spinal nerves, the sensory root has a gangliform enlargement upon it (the Gasserian ganglion). From this proceed the three main branches or divisions of the nerve. The two upper divisions are purely nerves of common sensation, while the lower, into which alone the motor root passes, is of very complex character, having among its branches—

1. Simple nerves of sensation (inferior dental; auriculo-temporal; buccal).
2. Nerves which convey motor power to certain muscles, and probably, like the spinal nerves, contain sensory fibres also.
3. A nerve of ordinary sensation and special sense combined (gustatory), and which by the addition of the chorda tympani from the seventh nerve contains motor filaments.

The branches of the fifth nerve towards their termination communicate freely with those of the seventh, and confer sensibility upon the muscles of the face which receive their motor power from the latter.

In connection with this nerve are four ganglionic masses, containing gray matter; each of these appears to be in communication (by *roots*) with a motor, a sensory, and a sympathetic nerve, and to give *branches* of distribution to contiguous structures.*

* [Each ganglion connected with the sympathetic system, whether the Cerebral (in connection with the fifth nerve) or Spinal, has three *roots*, Sensory, Motor, and Sympathetic, and also branches of *distribution*. The following table groups them together for convenient reference.

Name.	Situation.	Sensory Root.	Motor Root.	Sympathetic Root.	Branches of Distribution.	
CEREBRAL GANGLIA.	Ophthalmic or Ciliary.	Between Optic Nerve and Ext. Rectus	<i>Fifth Nerve</i> —First Division—Nasal branch.	<i>Third Nerve</i> .	Cavernous Plexus	Short Ciliary Nerves to Ciliary Muscle and Iris.
	Meckel's, or Spheno-Palatine.	Spheno-Palatine Fossa.	<i>Fifth Nerve</i> —Second Division—Spheno-Palatine branches.	<i>Seventh Nerve</i> through Vidian and large Superficial Petrosal.	Carotid Plexus through Vidian.	Orbital, Nasal, Naso-Palatine, Ant. or large Palatine, Middle or Ext. Palatine, Post. or Small Palatine to { Levator Palati. Azygos Uvulae. Palato-Glossus }
	Otic.	Below Foramen Ovale.	<i>Fifth Nerve</i> —Third Division—Auriculo-temporal branch.	<i>Seventh Nerve</i> through small Superficial Petrosal (probably); also from Int. Pterygoid branch of third division of fifth nerve.	Plexus on Middle Meningeal Artery.	To Tensor Palati and Tensor Tympani.
	Submaxillary	Above Submaxillary Gland.	<i>Fifth Nerve</i> —Third Division—Lingual branch.	<i>Seventh Nerve</i> through Chorda Tympani.	Plexus on Facial Artery.	To Submaxillary Gland and Mucous Membrane of the Mouth.
SPINAL GANGLIA.		From Spinal Nerve.	From Spinal Nerves.	From Ganglia above and below	To the internal viscera through various great Plexuses and the vessels. To the upper and lower extremities by the vessels.—K.]	

VI. *The Sixth Nerve (Abducens Oculi)* is the motor nerve of the external rectus muscle of the eyeball.

The SECOND PLATE shows the distribution of the remaining six pairs of cranial nerves.

VII. *The Facial Nerve*, or Portio dura of the seventh pair (Willis), is purely a nerve of motion, and is distributed to the muscles of the face [only to the muscles of expression.—K.]. Besides those named in the diagram in direct connection with it, the seventh appears also to supply through the large superficial petrosal (which, after being joined by a branch from the sympathetic, receives the name of Vidian, and enters Meckel's ganglion) some of the muscles of the soft palate, and through the chorda tympani the intrinsic muscular fibres of the tongue. Before their termination in the muscles, its branches communicate freely with the sensory fibres of the fifth nerve.

VIII. *The Auditory Nerve*, or Portio mollis of the seventh pair (Willis), is the special nerve of the sense of hearing, and is distributed to the internal ear.

IX. *The Glosso-Pharyngeal Nerve* gives filaments through its tympanic branch to some parts of the middle ear, but is chiefly distributed to the mucous membrane lining the upper part of the pharynx, the Eustachian tube, the arches of the palate, the tonsils, and to the sides and posterior part of the upper surface of the tongue. It is a nerve of the special sense of taste, and of ordinary sensation to the parts which it supplies, and is the chief centripetal nerve engaged in the action of deglutition.

It is doubtful whether it contains any motor filaments which are not derived from its communication with other nerves.

X. *The Pneumogastric or Vagus Nerve*, Par vagum of the eighth pair (Willis), has a most extensive distribution, giving branches to the pharynx, larynx, trachea, lungs, heart, oesophagus, and stomach [and through the Solar and other neighboring plexuses to the most of the Intestines.—K.] Its main trunk being of great length, it has been necessary in the diagram to give it a curve so as to adapt it to the size of the paper. It has numerous communications with other nerves, both cranial, spinal, and sympathetic, and its functions appear to be of very mixed character, partly motor, partly sensitive, and partly of a nature allied to those of the nerves of the sympathetic system.

XI. *The Spinal Accessory Nerve* is apparently entirely motor in its function. It arises from the upper part of the spinal cord, a considerable portion of it joins the pneumogastric (whence its name, "nervus spinalis ad par vagum accessorius"), the remainder is distributed to the sternocleido-mastoideus and trapezius muscles.

XII. *The Hypoglossal Nerve*, the ninth pair in the system of Willis, supplies all the extrinsic muscles of the tongue, as well as certain others in connection with the hyoid bone. Its proper function appears to be exclusively motor, such sensibility as it possesses being probably derived through its free communication with the spinal nerves.

PLATES III. AND IV.—THE SPINAL NERVES.

THE nerves which arise from the spinal cord have each two roots. Of these the posterior is somewhat larger than the other, has a ganglion situated upon it, and is composed solely of filaments which convey sensory impressions towards the cerebro-spinal centre. The anterior root, which has no ganglion, consists on the other hand of fibres which transmit motor power from the centre to the muscles. After the union of these roots, the resultant nerve is of mixed function, containing both motor and sensory fibres.

Directly the nerves issue from the intervertebral foramina, they divide into two branches; one of which, comparatively small, is directed posteriorly, and supplies the skin and muscles of the back. The anterior branches form the large nerves which are distributed to the neck, the lateral, and anterior parts of the trunk, and the extremities.

The spinal, like the cranial nerves, are symmetrically disposed on the two sides of the body. There are thirty-one pairs, divided, for the convenience of description, as follows: cervical, eight; dorsal, twelve; lumbar, five; sacral, five; coccygeal, one.

In Plate III. the distribution of the cervical and dorsal nerves is shown.

The anterior branches of the four upper constitute the **CERVICAL PLEXUS**; those of the four lower cervical, together with a large branch from the first dorsal, form the **BRACHIAL PLEXUS**.* The anterior branches of the dorsal nerves are called intercostal. Those below the third have not been represented in the diagram, as they all resemble each other, running forwards between the ribs, supplying the intercostal muscles, and giving off lateral and anterior cutaneous nerves to the surface of the chest.

Small filaments which pass from the anterior branches of all the spinal nerves near their commencement to the ganglia of the sympathetic system have been omitted here, to avoid the risk of obscuring any portions of the special objects of the diagram, but they will be seen in Plate V.

Plate IV. illustrates the distribution of the remaining spinal nerves. The anterior branches of the first three lumbar nerves and the greater part of that of the fourth constitute the **LUMBAR PLEXUS**. The large nervous cord formed by part of the fourth, and the whole of the fifth lumbar, together with the first three and part of the fourth sacral nerves (anterior branches), is called the **SACRAL PLEXUS**.

* [The formation of the brachial plexus can be readily remembered by observing the double bifurcation of the cords as indicated in the plate. The fifth, sixth, and seventh cervical unite to form one cord; the eighth cervical and first dorsal a second. Both of these bifurcate, the middle branches uniting, and thus **THREE** cords are formed. These three cords again bifurcate, and two median branches uniting form **FIVE** principal cords. The internal cutaneous nerves are readily added.—K.]

PLATE V.—THE SYMPATHETIC SYSTEM OF NERVES.

THE nerves of this system, also called TRI-SPLANCHNIC, GANGLIONIC, or NERVOUS SYSTEM OF ORGANIC LIFE, are chiefly destined to supply the viscera. They have abundant communications with the cerebro-spinal nerves, in which the fibres of the two systems appear mutually to interchange.

The small ganglia, connected with the fifth cranial nerve, are generally considered as belonging to the sympathetic system. They have been figured in Plate I., and are not repeated here. The ganglia on the glosso-pharyngeal and pneumogastric nerves, and those on the posterior roots of the spinal nerves, are also by some anatomists reckoned as part of it.

The remaining, and by far the largest portion (which is illustrated in this plate), consists of two chains of ganglia connected by intervening cords, situated in the posterior part of the neck, thoracic, and abdominal cavities, one on each side of the vertebral column, and extending from the upper part of the cervical region as far as the coccyx, where they unite in a single small ganglion (G. impar.). Each chain usually consists of twenty-four or twenty-five ganglia, having a generally symmetrical disposition on two sides of the body. Each ganglion is connected above and below with the neighboring ganglion of the chain; externally it has communication with one or more of the spinal nerves, and internally it sends off branches which mostly enter into the formation of certain large plexuses (prevertebral) situated near the median line in the visceral cavities of the body. [See note, p. 8.] These, after receiving further accessions from nerves of the cerebro-spinal system, send off branches for distribution to the various organs of the neck, thorax, abdomen, and pelvis. In these plexuses are situated many ganglia, each of which appears to be a centre for the development or modification of nerve force. This portion of the system, like the parts which it supplies, shows an absence of bilateral symmetry. The branches in reaching their destination almost always accompany bloodvessels, forming a fine network around them. [It is by these vascular branches that the sympathetic nerve is distributed to the upper and lower extremities.—K.]

In the diagram, to avoid useless repetition and obscurity, only one side of such parts of the sympathetic system as are double and symmetrical is given, therefore only one of the ganglionated cords with the ascending cranial branch from the first ganglion appears. The cardiae plexus is, like the organ it supplies, single; the cardiac nerves on both sides converging into it. The solar and hypogastric plexuses are also single, and situated in the median line. On each side of the former, where the great Splanchnic nerve joins it, a large ganglion (semilunar) is placed. Of the secondary plexuses derived from it, the diaphragmatic, supra-renal, renal, and spermatic are double, as are the arteries they accompany; but the hepatic, coronary, splenic, superior and inferior mesenteric, and aortic are single and asymmetrical.

The hypogastrie plexus divides below into two parts, which are situated on either side of the pelvic cavity, and give off the inferior haemorrhoidal and vesical plexuses, with prostatic and cavernous, or ovarian, vaginal, and uterine branches, according to the sex of the subject. It will be observed that this portion of the system is abundantly reinforced by branches which enter it directly from the sacral nerves, besides those that pass through the ganglionated cord.

PLATE VI.—DISTRIBUTION OF THE CUTANEOUS NERVES.

THIS diagram is intended to show the sources from which the sensibility of the different regions of the cutaneous surface is derived.

The position of the dotted lines which form the boundaries must be regarded only as approximate, as the exact distribution of the cutaneous nerves varies somewhat in different subjects, and as they interlace and communicate freely where they come in contact. [Hence, in paralysis of a cutaneous nerve, only the central part of its territory loses absolutely all sensibility, which gradually shades off into perfect touch at the margins.—K.]

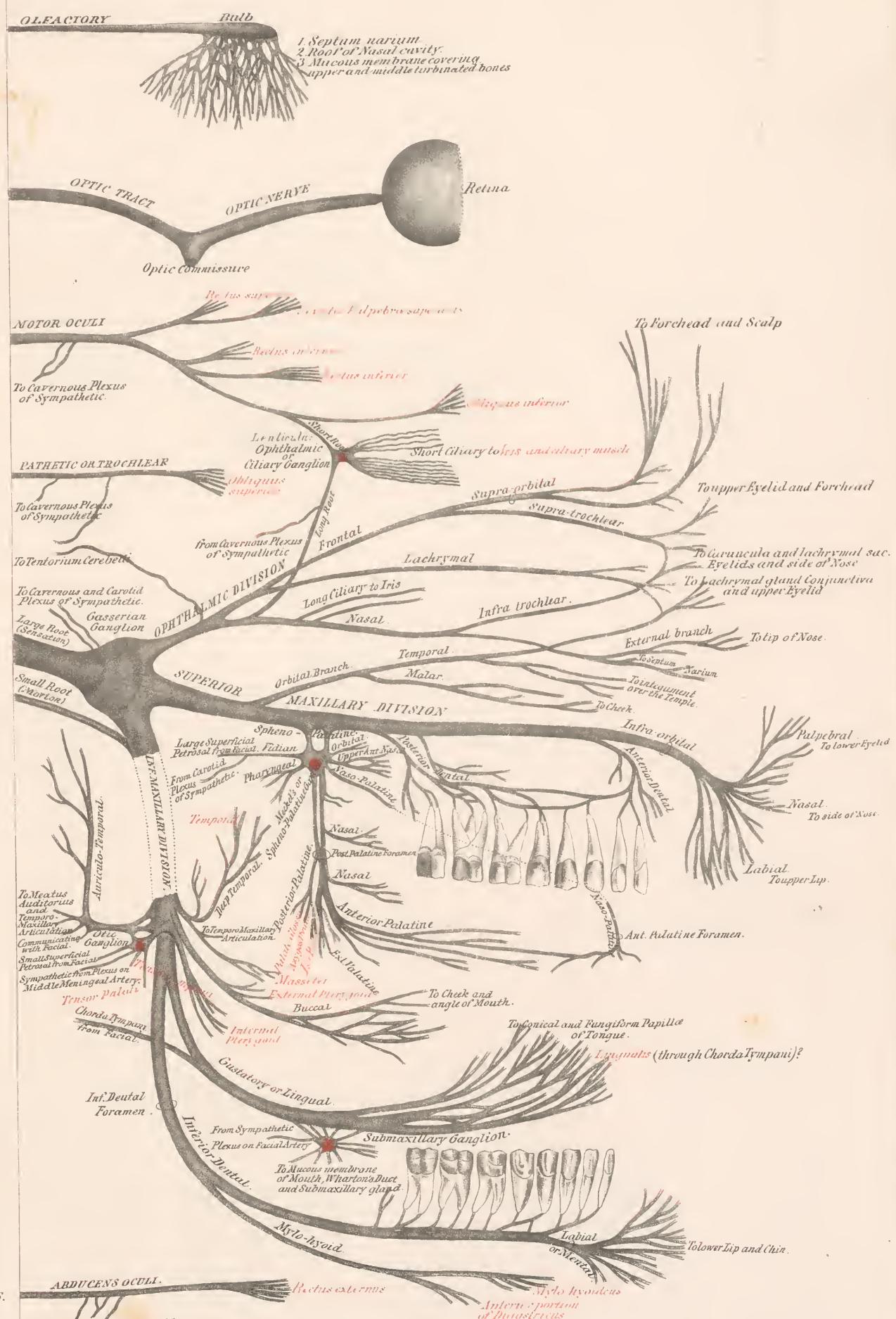
In order to trace the surface nerves to their connection with the cerebro-spinal axis with greater facility, an initial reference is given, below the name of the branch, to the main trunk or plexus from which it proceeds.

The explanation of these references is as follows:—

1. V. First (ophthalmic) division of fifth cranial nerve.
2. V. Second (superior maxillary) division of the same.
3. V. Third (inferior maxillary) division of the same.
- C. P. Cervical Plexus.
- B. P. Brachial Plexus.
- L. P. Lumbar Plexus.
- S. P. Sacral Plexus.

Plate I.

Origin from Surface of Encephalon	Foramen of Exit from Cranium and (unction)	Numerical Designation	Willis Sömmerring
By three roots from posterior margin of under surface of anterior lobe of Cerebrum.	Cyathiform plate of Ethmoid Bone Sagitt.	I	I
Optic Thalamus Corpora quadrigemina and geniculata	Foramen Opticum Right	II	2
Inner Surface of Crus cerebri close to Pons Varolii.	Sphenoidal Fissure Molt. m.	III	3
Valve of Vicusens	Sphenoidal Fissure. Molt. m.	IV	4
Anterior part of side of Pons Varolii	Sphenoidal Fissure Sensation 2 nd Div. Foramen rotundum. (Sensation) 3 rd Div. Foramen oreum. (Sensation, Motion to Muscles of Mastication Taste.)	V	5
Between Ant. Pyramid and Pons Varolii	Sphenoidal Fissure. (Motion)	VI	6



Cranial Nerves I to VI.

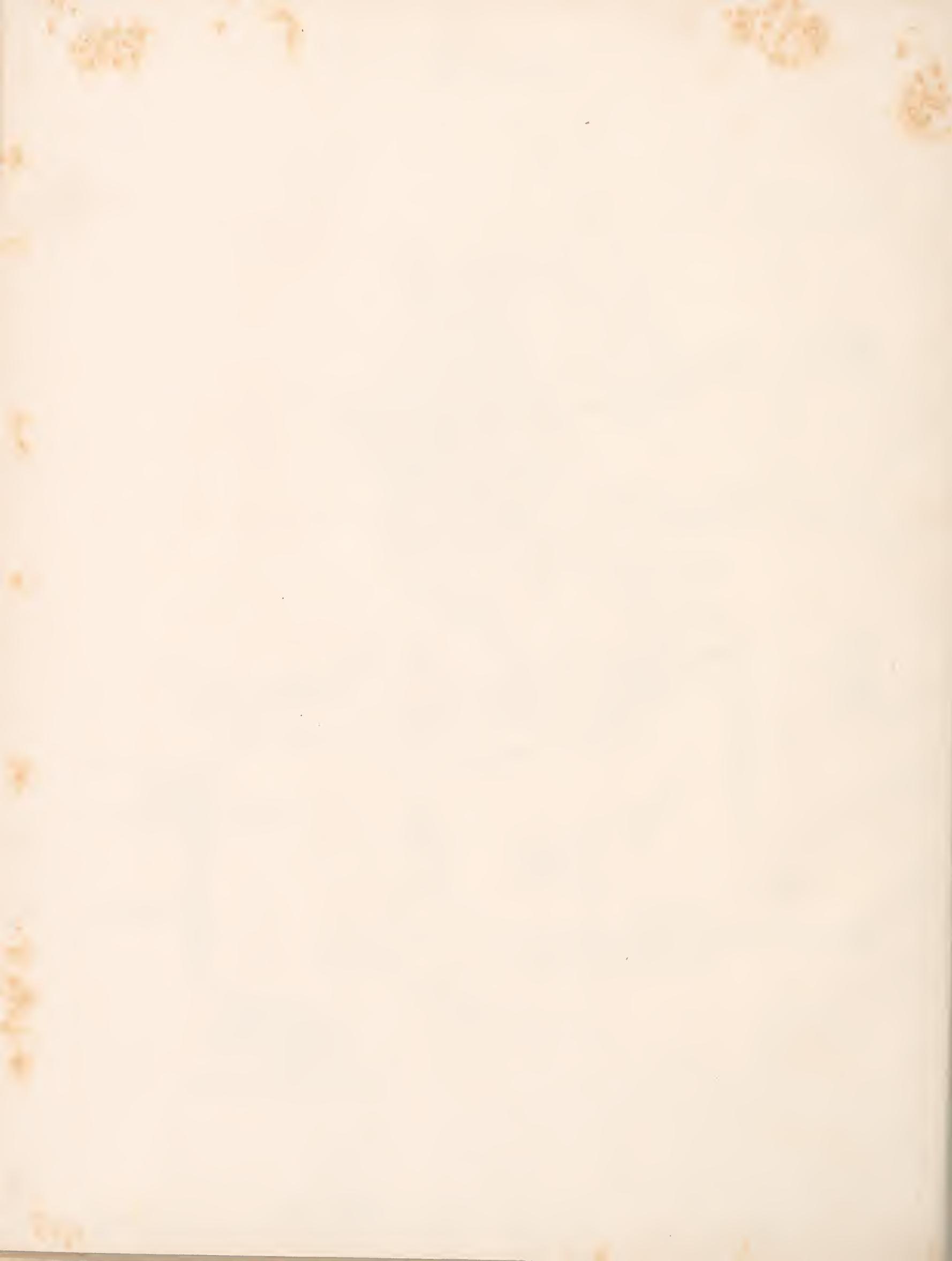


Plate III.
BRACHIAL PLEXUS.

CERVICAL PLEXUS.

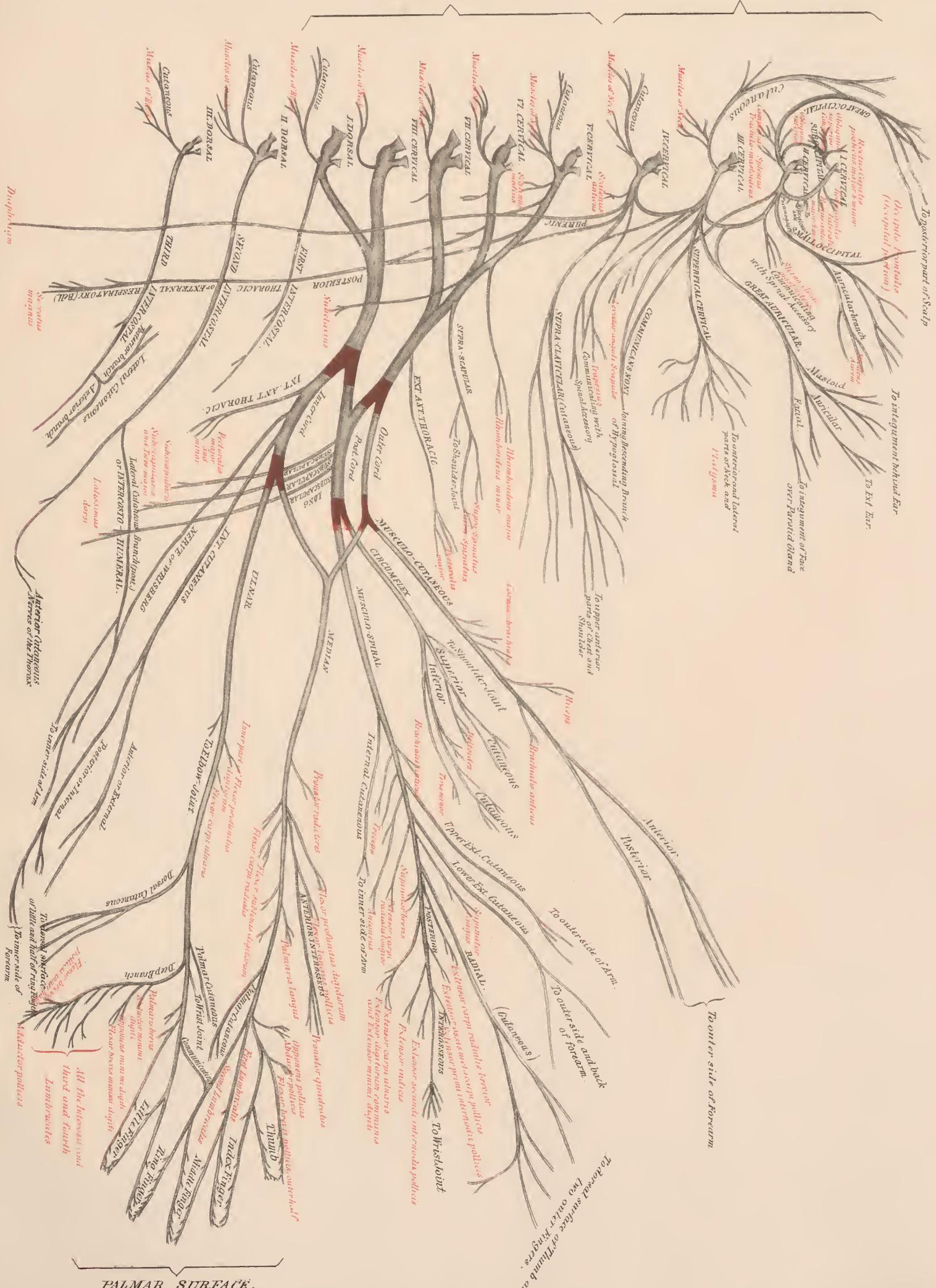


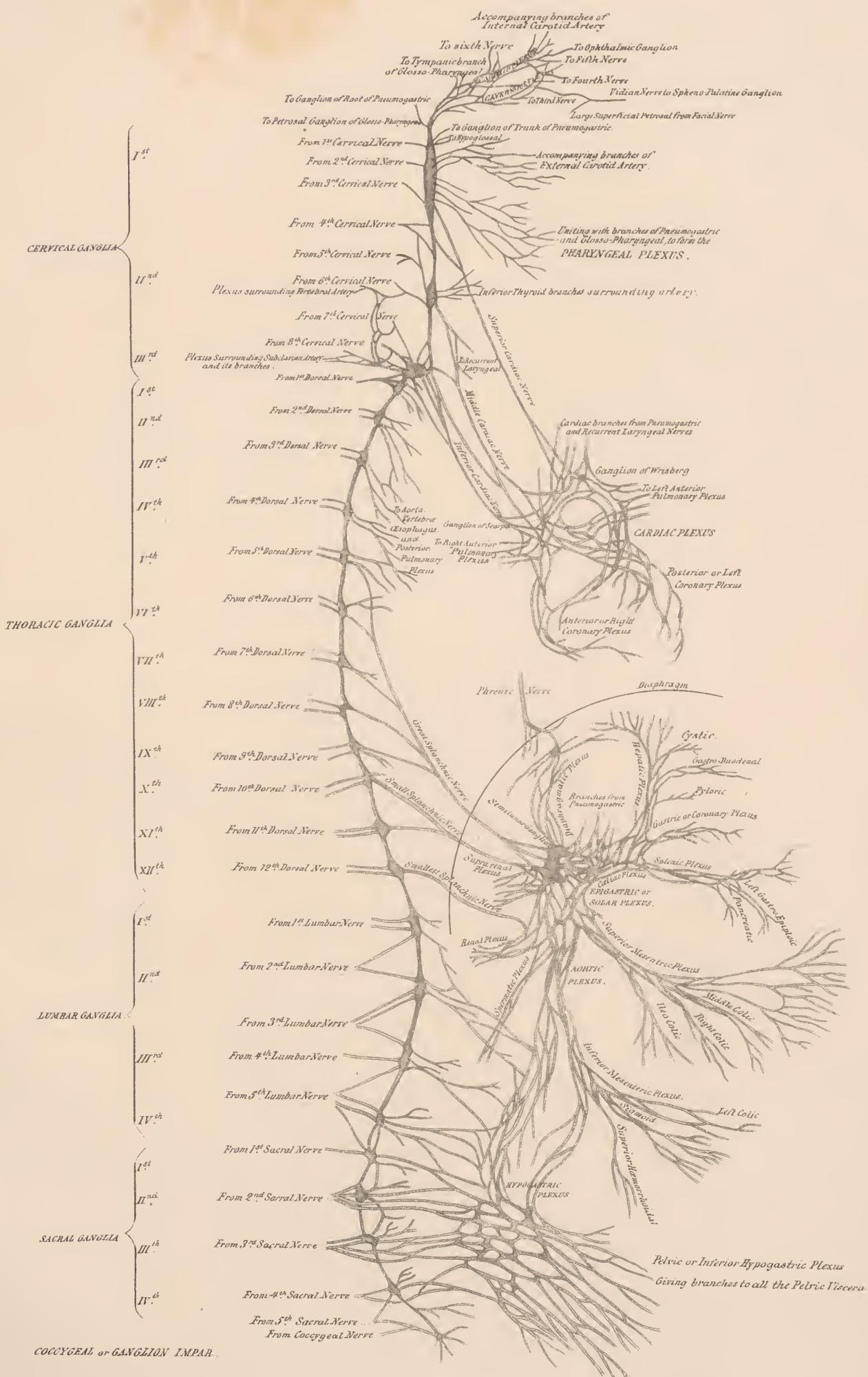


Plate IV.
SACRAL PLEXUS

LUMBAR PLEXUS



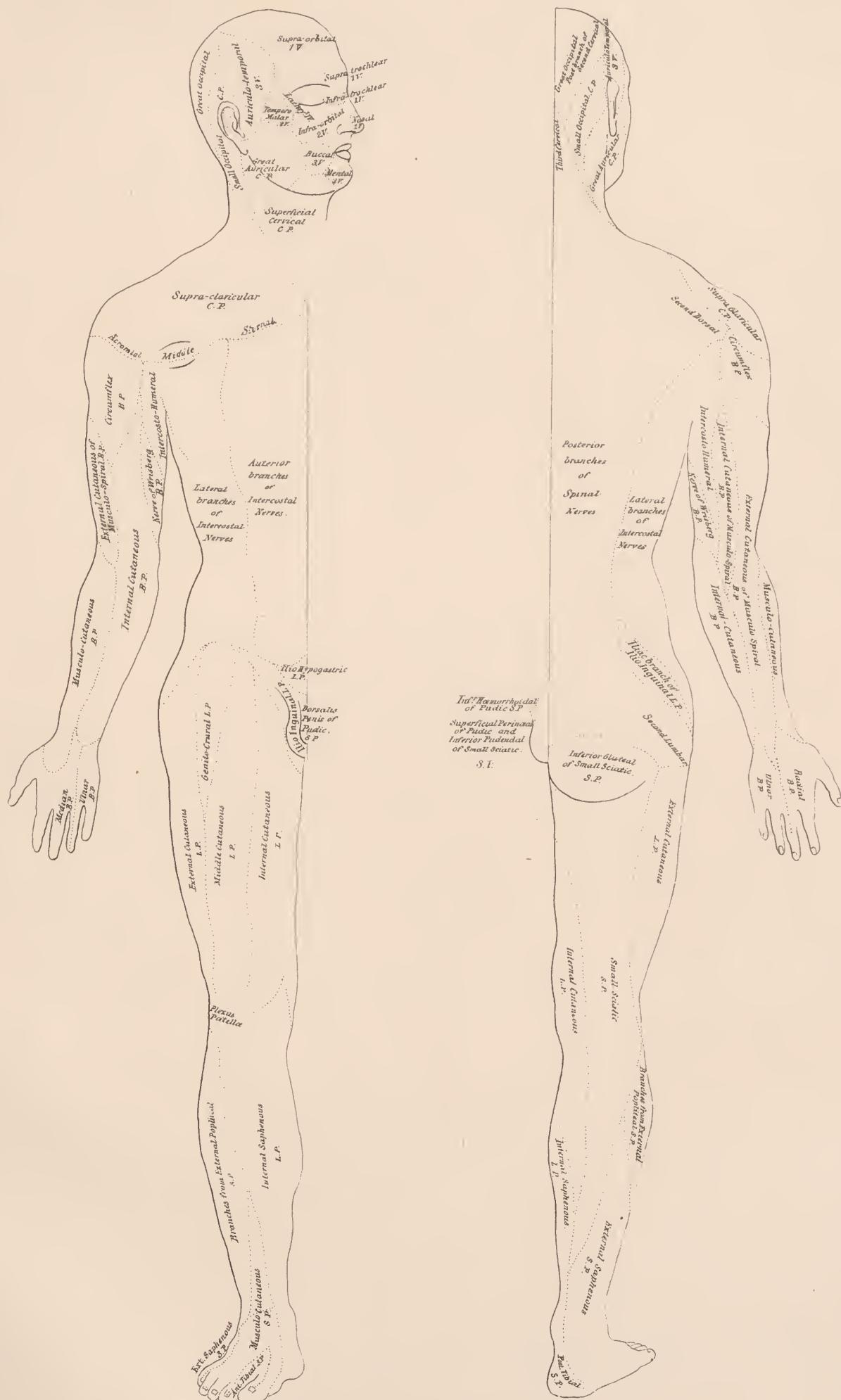
Plate V.



Sympathetic Nerve.

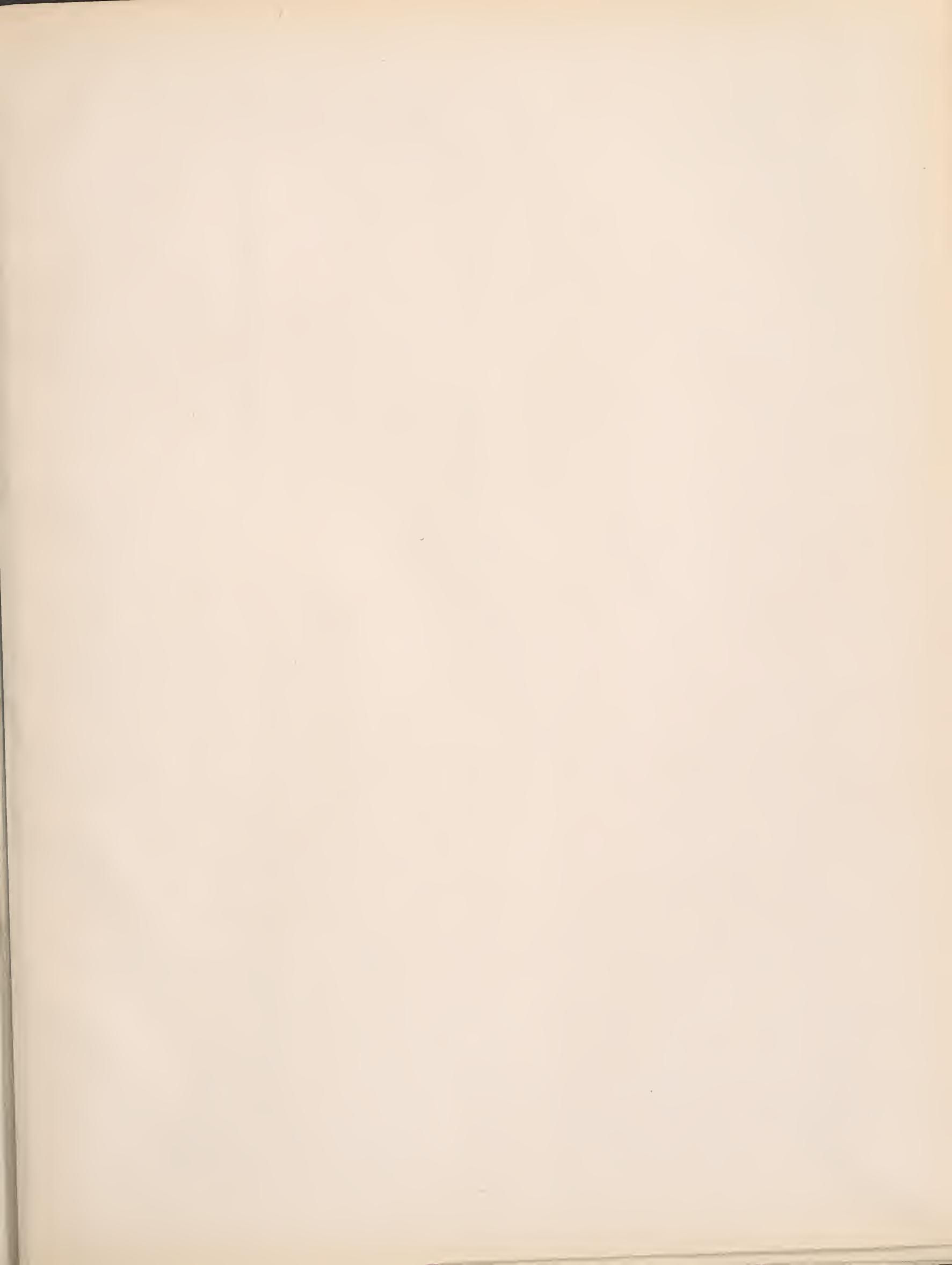


Plate VI.



Cutaneous Nerves.







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